LUNA Sensing Group

Rockmass monitoring

Silixa's DFOS rockmass monitoring solution provides continuous monitoring of rockmass deformation and seismic activity during block cave development.

CASE STUDY **Client location: Mongolia**

Challenge

The mining operator required improved visibility of rockmass behaviour and deformation in critical underground areas.

Traditional point-based monitoring methods provided limited spatial coverage and could not continuously identify changes along the full length of the monitored zones.

Solution

Deploy Silixa's Distributed Fibre Optic Sensing (DFOS) solution for continuous rockmass monitoring. Fibre optic sensing cables were installed within boreholes to provide distributed measurements of strain and microseismic activity along the rockmass, enabling continuous monitoring over extended distances from a single sensing system.

Results

The DFOS solution provided continuous, high-resolution insight into rockmass deformation and seismic activity, helping identify changes in rockmass behaviour and potential instability.

The distributed nature of the sensing technology enabled the operator to monitor large sections of the rockmass rather than relying solely on discrete measurement points, supporting improved ground control, hazard identification and mine safety.

Background information

Block caving is a complex mining method in which the progressive failure and movement of the rockmass are fundamental to safe and efficient production.

Understanding how the rockmass responds to cave initiation and propagation is critical for managing ground stability, cave propagation, draw control and operational risk.

Traditional monitoring methods, such as extensometers, convergence measurements, microseismic arrays and point-based instrumentation, provide valuable information but are often limited by the number and location of monitoring points and may not capture deformation occurring between individual sensors.

DFOS provides a new approach to rockmass monitoring by enabling continuous measurements along the entire length of a sensing fibre installed within boreholes. By combining Distributed Strain Sensing (DSS) with Distributed Acoustic Sensing (DAS), the system can provide complementary information on both the gradual deformation of the rockmass and dynamic seismic activity associated with fracturing and cave development.

In recent years, Silixa has developed DFOS-based rockmass monitoring solutions with successful field deployments in large-scale underground mining operations, providing operators with continuous, spatially distributed visibility of rockmass behaviour that complements conventional geotechnical monitoring.

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Value creation to client

A permanent DFOS installation provides the mining operator with a continuous, distributed view of rockmass behaviour along the monitored boreholes. Unlike conventional point-based instrumentation, the fibre optic sensing cable acts as a continuous sensing element, allowing deformation and dynamic rockmass responses to be detected at any location along the instrumented borehole.

The combination of DSS and DAS enables the system to monitor both gradual rockmass deformation and dynamic seismic activity associated with fracturing and cave development. This provides a more comprehensive understanding of the initiation and progression of rockmass failure and its spatial relationship to the cave.

Because optical fibre is lightweight, passive and immune to electromagnetic interference, DFOS can be deployed over long distances and integrated into existing borehole infrastructure. A single sensing installation can therefore provide thousands of distributed measurement points, reducing the need for large numbers of discrete sensors.

The technology is particularly attractive for large-scale block-caving operations, where understanding how the rockmass is responding across extensive areas is essential for ground-control management, cave propagation assessment and operational decision-making.

By providing continuous data from previously unmonitored sections of the rockmass, DFOS can complement existing monitoring systems and provide the operator with earlier and more detailed insight into changing ground conditions, supporting improved safety and more informed mine planning and production decisions.

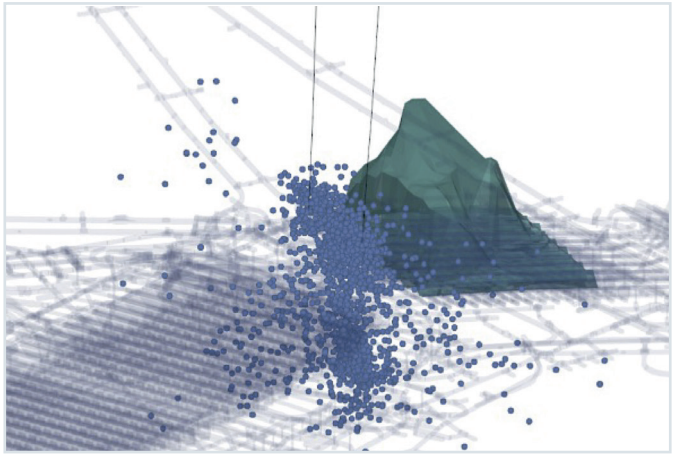


Figure 1: Distributed microseismic monitoring around the panel, showing two instrumented boreholes and the spatial distribution of detected microseismic events. The event locations provide insight into the progression and spatial extent of rockmass fracturing and cave development around the monitored area.

Why DFOS Rockmass Monitoring?

Significant cost-savings

Silixa's DFOS solution can monitor extensive sections of the rockmass using a single continuous length of fibre optic cable, significantly reducing the number of discrete sensors and associated installation requirements. The system can be deployed in existing boreholes, making it suitable for both brownfield and greenfield mining operations. Multiple sensing points can be provided along a single borehole, offering a highly attractive cost-per-measurement ratio for large-scale rockmass monitoring.

Improved monitoring coverage

DFOS provides continuous, spatially distributed measurements along the entire length of the sensing fibre rather than only at discrete instrument locations. By DSS and DAS, operators can monitor both progressive rockmass deformation and dynamic seismic activity, providing a more comprehensive understanding of rockmass behaviour, fracturing and cave propagation.

Increased efficiency

DFOS enables continuous, automated data acquisition from large and potentially inaccessible areas of the mine. The system can monitor multiple boreholes and large volumes of rockmass with minimal intervention, providing operators and geotechnical teams with continuous data to support ground-control decisions, cave management and mine planning.

Increased safety

Continuous remote monitoring reduces the requirement for personnel to regularly access potentially hazardous areas to collect measurements. Early identification of changes in rockmass behaviour can provide valuable information for hazard assessment and ground-control management, supporting safer underground operations.

Scalable monitoring

The distributed nature of fibre optic sensing makes the technology particularly suitable for large-scale block-caving operations, where monitoring requirements can extend over hundreds or thousands of metres. Additional boreholes and sensing zones can be incorporated as the cave develops, allowing the monitoring system to evolve with the mine.